

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In the Matter of

Additional Spectrum for Unlicensed Devices
Below 900 MHz and in the 3 GHz Band

ET Docket No. 02-380

COMMENTS OF THE SOFTWARE DEFINED RADIO FORUM

The Software Defined Radio Forum (“SDR Forum”) commends the Commission for beginning to implement the recommendations of last fall’s *Spectrum Policy Task Force Report*¹ by issuing this *Notice*.² While the SDR Forum does not comment on allocation matters in any particular band, it can comment on how advanced radio technology—and, increasingly, SDR technology—is *today* enabling the kind of “opportunistic use” envisioned by the Commission. The Commission should now focus on generating the technical and engineering record necessary to advance the goals of this *Notice* and the *Report*. As the global clearinghouse for many of the technologies implicated in the *Notice*, the SDR Forum looks forward to assisting the Commission in this regard.

¹ *Spectrum Policy Task Force*, Report, ET Docket No. 02-135 (Nov. 2002) (“*SPTF Report*”).

² *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, Notice of Inquiry, ET Docket No. 02-380, FCC No. 02-328 (rel. Dec. 20, 2002) (“*Notice*”).

I. BACKGROUND

The SDR Forum is an international, non-profit organization dedicated to promoting the development, deployment and use of SDR technologies³ for advanced wireless systems. More than 100 organizations throughout the world are members of the SDR Forum. These member entities encompass decision-makers, planners, policy-makers, technologists, suppliers/manufacturers, educators, and program/product managers from a broad range of organizations.

The SDR Forum, because of its diverse, global membership, represents an industry-wide perspective. It is not, and cannot be, associated with a specific wireless technology, or with the objectives of any single entity or radio service. The SDR Forum therefore intentionally avoids comment on allocation issues in specific bands. It can, however, comment about how SDR technology can enable the kinds of innovative spectrum management techniques being considered by the Commission. It also stands ready to help the Commission develop the technical and engineering record as this proceeding moves forward.

II. THE SDR FORUM COMMENDS THE COMMISSION FOR BEGINNING TO IMPLEMENT THE SPECTRUM POLICY TASK FORCE’S RECOMMENDATIONS

Over the past several months, the Commission has increasingly emphasized the role that technology can play in making spectrum use more efficient. Indeed, Chairman Powell made this a central topic in a recent discussion of wireless policy:

³ The Commission defines a “Software Defined Radio” as one in which “operating parameters such as the frequency and modulation type are determined by software.” *Authorization and Use of Software Defined Radios*, First Report and Order, 16 FCC Rcd. 17,373, 17,373 (2001). More specifically, a Software Defined Radio is one “that includes a transmitter in which the operating parameters of frequency range, modulation type or maximum output power (either radiated or conducted) can be altered by making a change in software without making any changes to hardware components that affect the radio frequency emissions.” *Id.*, 16 FCC Rcd. at 17,375.

Modern technology has fundamentally changed the nature and extent of spectrum use. . . . [t]he good news is that while the proliferation of technology strains the old paradigm, it is also technology that will ultimately free spectrum from its former shackles.⁴

Commissioners Abernathy,⁵ Martin,⁶ Copps,⁷ and Adelstein⁸ have expressed similar sentiments.

The Commission's Spectrum Policy Task Force addressed the potential role of technology in more detail, suggesting that "technological advances are . . . providing some potential answers to current spectrum policy challenges."⁹ Perhaps most relevant to this proceeding, the Task Force elaborated:

[G]iven the increased ability of new technologies to monitor their local RF environment and operate more dynamically than traditional technologies, the predictive models used by the Commission can be updated, and perhaps eventually replaced, by techniques that take into account and assess actual, rather than predicted, interference. . . . Often, technologies such as software-defined radios are called "smart" or "opportunistic" technologies because, due to their operational flexibility, software-defined radios can search the radio spectrum, sense the environment, and operate in spectrum not in use by others. By operating in so-called white—or unused—spaces in the spectrum, software-defined radios can enable better and more intensive use of the radio spectrum."¹⁰

⁴ "Broadband Migration III: New Directions in Wireless Policy," Remarks of Michael K. Powell, Chairman, FCC, at the University of Colorado at Boulder (Oct. 30, 2002).

⁵ See "My Vision of the Future of American Spectrum Policy," Remarks of Kathleen Q. Abernathy, Commissioner, FCC, before the Cato Institute (Nov. 14, 2002) (comparing a "commons approach," described as an "engineer's dream," with the traditional, "private property-like rights model," described as a "lawyer's dream").

⁶ See "U.S. Spectrum Policy: Convergence or Co-Existence?," Remarks by Kevin J. Martin, Commissioner, FCC, to the FCBA Policy Summit and CLE (Mar. 5, 2002) (noting that "[a]dvances in software defined radios permit increases in efficiency by allowing quick modification to transmit and receive on any frequency and in any desired transmission format").

⁷ See *Notice*, Statement of Commissioner Michael J. Copps (stating that "unlicensed technologies are extremely important to the future of the Commission's management of the spectrum because they may provide us with spectrum resources that our current spectrum management paradigm doesn't recognize").

⁸ See "New Frontiers in Wireless Policy: A Framework for Innovation," Remarks of Jonathan S. Adelstein, Commissioner, FCC, before the Silicon Flatirons Telecommunications Program, University of Colorado at Boulder (Apr. 9, 2003) (stating that, "in order to improve our country's use of [spectrum], we need to improve access and innovation" and that "[i]t is the Commission's obligation to explore all new technologies available to us to ensure that we are advancing and improving our nation's access to spectrum-based services").

⁹ *SPTF Report* at 13.

¹⁰ *SPTF Report* at 13-14.

The implications of such opportunistic use are immense. Under a traditional command and control regime, the Commission would identify (or create by re-allocation) bands of “white-space” into which it would then authorize a designated service to operate. In contrast to such an *ex ante* regulatory process, advanced radio technologies can perform such allocation functions in real-time. Advanced radios can be continuously “cognitive” of their operating environment and operate in a non-interfering fashion on an opportunistic basis—in essence, substituting “MIPS”¹¹ for service-specific allocations. The Task Force recognized this potential in recommending that the Commission “[c]onsider methods for additional spectrum access for unlicensed devices,” including “[o]ppportunistic or dynamic use of existing bands—through either cognitive radio techniques to find ‘white space’ in existing bands or use protocols to get out of the way of primary users.”¹²

As an organization devoted to developing such technologies, the SDR Forum supports the Commission’s efforts, and endorses the Task Force’s recommendations. General recommendations, however, are only a starting point. The much larger task facing the Commission is to turn these good ideas into actions that will result in tangible benefits for US consumers, business, and the economy. This *Notice* represents a crucial first step.

¹¹ “Millions of Instructions Per Second.” See Harry Newton, *Newton’s Telecom Dictionary* 541 (16th ed. 2000).

¹² *SPTF Report* at 67.

III. SDR TECHNOLOGIES CAN ENABLE MANY OF THE SPECTRUM MANAGEMENT TECHNIQUES IDENTIFIED IN THE *NOTICE*

Simply by seeking comment on whether unlicensed devices can “operate in TV broadcast spectrum at locations and times when spectrum is not being used,”¹³ the *Notice* illustrates the potential of opportunistic use. As the *Notice* acknowledges, this potential is considerable, offering “significant benefits to the economy, businesses and consumers by allowing the development of new and innovative types of unlicensed devices.”¹⁴

Opportunistic use requires, first, the identification of white space in which to operate. As identified in the *Notice*, this can be accomplished by having radios (or the network) determine their geographic location, and cross-check that location with known radio transmissions through a centrally-located database.¹⁵ This can also be accomplished by having radios themselves monitor the RF environment to detect the interference environment around them.¹⁶ Once white space is identified, radios would adopt their performance (frequency, power, etc.) accordingly.

Advanced radio technologies—and, increasingly, SDR technologies—are *already* performing many of these tasks:

- Mobile phones already perform dynamic power control, execute sophisticated algorithms for spread spectrum, and, indeed, often incorporate location technology. In addition, mobile phones operate in compliance with dozens of dynamic roaming agreements, which represent a geographic coordination challenge far greater than that contemplated in the *Notice*.

¹³ *Notice* at ¶ 1.

¹⁴ *Id.*

¹⁵ *See Notice* at ¶ 13 (stating that “a device could have the capability of ‘knowing’ where it is, and could use information obtained from a database to determine whether there are any licensed operations in its vicinity”).

¹⁶ *See id.* (stating that, “[f]or example, advances in computer technology mean that it should be possible to design equipment that would monitor the spectrum to detect frequencies already in use and ensure that transmissions only occur on open frequencies”).

- Recent discussions between the Department of Defense and industry concerning the 5250-5350 MHz and 5470-5725 MHz bands have demonstrated that opportunistic radios will be able to share spectrum with incumbent services—including military services, which are often less “interference tolerant” than corresponding civilian services. Commercial radios will be able to detect military transmissions, and adjust frequency in real-time to avoid those transmissions.
- SIGFX, LLC has an experimental license in Mississippi, under which it provides two-way communications during the vertical blanking interval of an active TV signal. In order to do so, it processes severely unbalanced signals (signals that operate near or below the noise floor) using smart antenna technology and intelligent batteries. Its technology constantly measures the characteristics of the spectrum environment, allowing the wireless devices to modify their operating frequency, coding schemes, and compression algorithms.¹⁷
- Shared Spectrum Company has developed dynamic spectrum management applications and low-cost transceivers that operate from VHF frequencies to 3 GHz. This technology enables frequency agile radios to dynamically share the spectrum on a non-interference basis with existing users.¹⁸ According to Shared Spectrum, “[t]hese advances enable current and future wireless systems to avoid causing interference and to be tolerant of interference.”¹⁹
- The Automatic Link Establishment (“ALE”) System, which operates in the HF band, uses dynamic frequency assignment algorithms to monitor existing traffic and select open frequencies. The ALE System has been used by the Air Force’s HF Global Communications Systems Air/Ground Network, Shares (an amateur radio network), the Federal Emergency Management Agency’s National Radio System, and other groups for many years.²⁰

Again, the SDR Forum takes no position with respect to allocations in any particular bands. The above examples demonstrate, however, that the technology required to implement the kinds of sharing mechanisms envisioned in the *Notice* are quite modest compared to the technology already incorporated in radio devices today.²¹

¹⁷ See www.sigfx.com (describing SIGFX’s technology).

¹⁸ See <http://www.sharedspectrum.com> (describing Shared Spectrum’s technology).

¹⁹ Comments of Shared Spectrum Company, ET Docket No. 02-135, at 2 (filed Jan. 27, 2003).

²⁰ See Reply Comments of Shared Spectrum Company, ET Docket No. 02-135, at 7 (filed Feb. 28, 2003).

²¹ See *Notice* at ¶ 16 (asking whether “frequency agile equipment, as well as the protocols to enable efficient frequency sharing, [are] feasible in the near-term”).

IV. THE COMMISSION SHOULD ISSUE AN NPRM IN THIS PROCEEDING

This *Notice* is an important first step in implementing the Spectrum Policy Task Force’s recommendations. It is, however, only a first step. The Commission should now move to a more focused Notice of Proposed Rulemaking (“NPRM”), which could lay the groundwork for an expeditious even if initially limited deployment of devices. This would be the best way for the Commission to gain real-world experience with opportunistic technologies and spectrum management techniques.

Moreover, an NPRM is likely to result in an even fuller public record than this NOI will produce. Notices of Inquiry are designed to be “broad but shallow”—meaning that the Commission usually seeks modest amounts of information about many questions. This *Notice*, in particular, is understandably quite broad.²² But in this era of limited resources, entities may find themselves unable to devote the engineering and technical resources to fully respond in detail to all of the questions posed by the *Notice*.

An NPRM, by contrast, is generally more focused—allowing industry better to concentrate its resources and generate the necessary technical due diligence. For example, an NPRM might focus on opportunistic unlicensed use by only one or a couple of classes of unlicensed devices—making it far easier to generate technical information than it would be to generate such information for every conceivable unlicensed device. An NPRM could thus generate a technical record enabling rapid deployment of opportunistic unlicensed devices with maximum initial economic value and minimum potential for interference to incumbent users. As real-world experience with opportunistic use is gained, further NPRMs could well follow.

²² The *Notice* contains twenty-four bullet points, each in turn containing several questions.

V. THE SDR FORUM CAN HELP DEVELOP THE ENGINEERING AND TECHNICAL RECORD AS THIS PROCEEDING MOVES FORWARD

Since 1996, the SDR Forum has been the global clearinghouse for advancement of the core technologies that will enable the innovative devices and spectrum management techniques foreseen by the Commission. Indeed, the SDR Forum's ongoing work program addresses a number of topics raised in the *Notice*, such as:

- Development of new and innovative types of wireless devices.
- Advances in computer technology allowing monitoring of spectrum and avoidance of radio interference.
- Technology advances allowing dynamic control of bandwidth, power, and other RF features.
- Consideration of necessary technical requirements for SDR devices.
- Reliability and security considerations for software reconfiguration.
- Near-term deployment of frequency agile equipment.²³

In light of this extensive experience and expertise, the SDR Forum can facilitate technical and analytic collaboration among the interested parties, particularly as the Commission moves forward with an NPRM.

For example, the SDR Forum last year held its first-ever technical conference dedicated to Software Defined Radio technologies,²⁴ and a second conference is scheduled for this November. This year's conference is expected to yield additional technical analysis and information that should prove useful to the Commission.

²³ See Software Defined Radio Forum, Structure and 2003 Unified Work Plan (Mar. 17, 2003), available at <http://www.sdrforum.org/>; *Notice* at ¶¶ 15-16 (discussing technical requirements for unlicensed devices operating in the television broadcast bands).

²⁴ The proceedings of last year's technical conference are available to Commission staff and all interested parties. See http://www.sdrforum.org/MTGS/sandiego_11_02_agenda.html.

Moreover, the SDR Forum will co-sponsor a workshop in June on advances in smart antennas. The event, to be sponsored jointly with Virginia Tech's MPRG Thirteenth Annual Symposium on Wireless Personal Communications, is expected to provide the latest information on smart antenna solutions. With respect to these and future technical undertakings, the Forum will transmit the relevant results to Commission staff as appropriate and in the proper form.

VI. CONCLUSION

In issuing this *Notice*, the Commission has taken the first step in implementing the Spectrum Policy Task Force's recommendations. It should now take the next steps to develop the necessary technical and engineering record in this proceeding by issuing an NPRM. The SDR Forum hopes to assist the Commission along the way.

Respectfully submitted,

THE SOFTWARE DEFINED RADIO FORUM

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April 17, 2003